U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Trifolium friscanum

Common Name:

Frisco clover

Lead region:

Region 6 (Mountain-Prairie Region)

Information current as of:

05/31/2012

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

> ___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status
>
> ___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species
>
> ___ Range is no longer a U.S. territory
>
> ___ Insufficient information exists on biological vulnerability and threats to support listing
>
> ___ Taxon mistakenly included in past notice of review
>
> ___ Taxon does not meet the definition of "species"
>
> ___ Taxon believed to be extinct
>
> ___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 07/30/2007

90-Day Positive:08/18/2009

12 Month Positive:02/23/2011

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Utah
- **US Counties**: Beaver, UT, Millard, UT
- **Countries**: United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Utah
- **US Counties**: Beaver, UT, Millard, UT
- **Countries**: United States

Land Ownership:

Trifolium friscanum (Frisco clover) is a narrow endemic known from five small populations on private (68 percent of the known individuals), State of Utah School and Institutional Trust Lands Administration (SITLA) (2 percent of the known individuals), Bureau of Land Management (BLM) (13 percent of the known individuals), and U.S. Forest Service (USFS) (16 percent of the known individuals) lands.

Lead Region Contact:

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Biological Information

Species Description:

Trifolium friscanum (Frisco clover) is a dwarf mat-forming or tufted perennial herb in the legume family (Fabaceae). For the purposes of this document, we will refer to *Trifolium friscanum* as “Frisco clover.” Plants have a taproot and thick woody stem. Frisco clover is up to 1.2 inches (3 centimeter) tall and has silver hairy leaves composed of three leaflets (Welsh *et al*. 2008, p. 486). Its flowers resemble those of other clover species and are arranged in heads of four to nine reddish-purple flowers with pale wings (Figure 2; Welsh *et al*. 2008, p. 486).

Figure 2. Frisco clover plant. Photo: D. Roth, USFWS

Taxonomy:

Frisco clover was originally described by Stanley Welsh as *T. andersonii* var. *friscanum* from specimens collected on Grampian Hill in the southern San Francisco Mountains in Beaver County, Utah (Welsh 1978, p.

355). The variety was elevated to species level in 1993 (Welsh 1993, p. 407). We accept the current taxonomy and consider Frisco clover to be a valid species and a listable entity under the ESA.

Habitat/Life History:

Frisco clover is a narrow endemic restricted to soils derived from volcanic gravels, Ordovician limestone, and dolomite outcrops. Soils are shallow, with gravels, rocks, and boulders on the surface (Kass 1992, p. 3; Miller 2010d, p. 1).

In the southern San Francisco Mountains, where the majority of plants are located, there are 845 acres (ac) (342 hectares (ha)) of Ordovician limestone and 719 ac (291 ha) of dolomite outcrops (Darnall *et al.* 2010, entire). Ordovician limestone is rare within a 50-mile (mi) (80-kilometer (km)) radius of the San Francisco Mountains, but dolomite outcrops are common in the Wah Wah Mountain Range to the west (Miller 2010g, Appendix F). We have no information on the extent of volcanic gravels in the area. We do not know if there are other limiting factors associated with the limestone and dolomite formations that restrict the habitat use and distribution of the species; the species occupies only a fraction of the available habitat. The two largest populations— Grampian Hill and San Francisco—occupy an estimated 35 ac (14 ha) (2.3 percent) of the available limestone and dolomite outcrops (Darnall *et al*. 2010, entire). We do not have occupied habitat area totals for the remaining three populations, but we believe they are smaller, based on field evaluations and the lower number of individuals in these populations (Kass 1992, p. 3; Miller 2010d, p. 1; Roth 2010, pp. 1–2).

Frisco clover is typically found within sparsely vegetated pinion-juniper-sagebrush communities between 5,640 and 8,440 feet (1,720–2,573 meters) in elevation.

Associated species include *Ephedra* spp. (Mormon tea), *Gutierrezia sarothrae* (snakeweed), *Cercocarpus intricatus* (dwarf mountain-mahogany), and *Petradoria pumila* (rock goldenrod). Associated rare species in the southern San Francisco Mountains include *Eriogonum soredium* (Frisco buckwheat) and *Lepidium ostleri* (Ostler's peppergrass), which generally grow on the same substrate in similar but more open habitats adjacent to Frisco clover. Flowering occurs from late May to June, followed by fruit set in June through July (Welsh *et al*. 2008, p. 486). No other information is available on the life history of this species.

Historical Range/Distribution:

Frisco clover is historically and currently (see Current Range/Distribution, below) known from five populations on private, SITLA, BLM, and USFS lands in Beaver and Millard Counties, Utah (Figure 1; Kass 1992, pp. 4–5; Evenden 1998, pp. 6–7, Appendix C; Evenden 1999, pp. 2–3; Miller 2010c, pp. 1, 4; Miller 2010e, pers. comm.; Roth 2010, p. 4).

Current Range Distribution:

Frisco clover is a narrow endemic known from five small populations containing nine sites on private, SITLA, BLM, and USFS lands in Beaver and Millard Counties, Utah (Figure 1; Table 1; Kass 1992, pp. 4–5; Evenden 1998, pp. 6–7, Appendix C; Evenden 1999, pp. 2–3; Miller 2010c, pp. 1, 4; Miller 2010e, pers. comm.; Roth 2010, p. 4). Populations are defined as groups of sites located in the same geographic vicinity. Sites are defined as occurrence records or locations recorded by one or more researchers over time within an individual population. Despite additional searches in the San Francisco Mountains and surrounding areas (including the Wah Wah Mountains, the Confusion Range, the Mountain Home Range, and the Tunnel Springs Mountains), no other populations are known to occur (Kass 1992, pp. 4–5; Evenden 1998, pp. 6–7, Appendix C; Evenden 1999, pp. 2–3; Miller 2010c, pp. 1, 4; Miller 2010e, pers. comm.; Roth 2010, p. 4).

The five populations occur within three mountain ranges in southwestern Utah (Figure 1, Table 1). The two largest populations, the Grampian Hill and San Francisco Populations, occur on the southern tip on the San Francisco Mountains in Beaver County. East of the San Francisco Mountains are the Beaver Lake Mountains, where the Lime Mountain Population occurs on Lime Mountain. West and south of the San Francisco Mountains are the Wah Wah Mountains. Along the southeastern edge of the Wah Wah Mountains is the southernmost population, the Blue Mountain population, which occurs along the Beaver–Iron County boundary line on Blue Mountain. The Tunnel Springs Population occurs in the Tunnel Springs Mountains in Millard County. The Tunnel Springs Mountains are west and north of the Wah Wah Mountains.

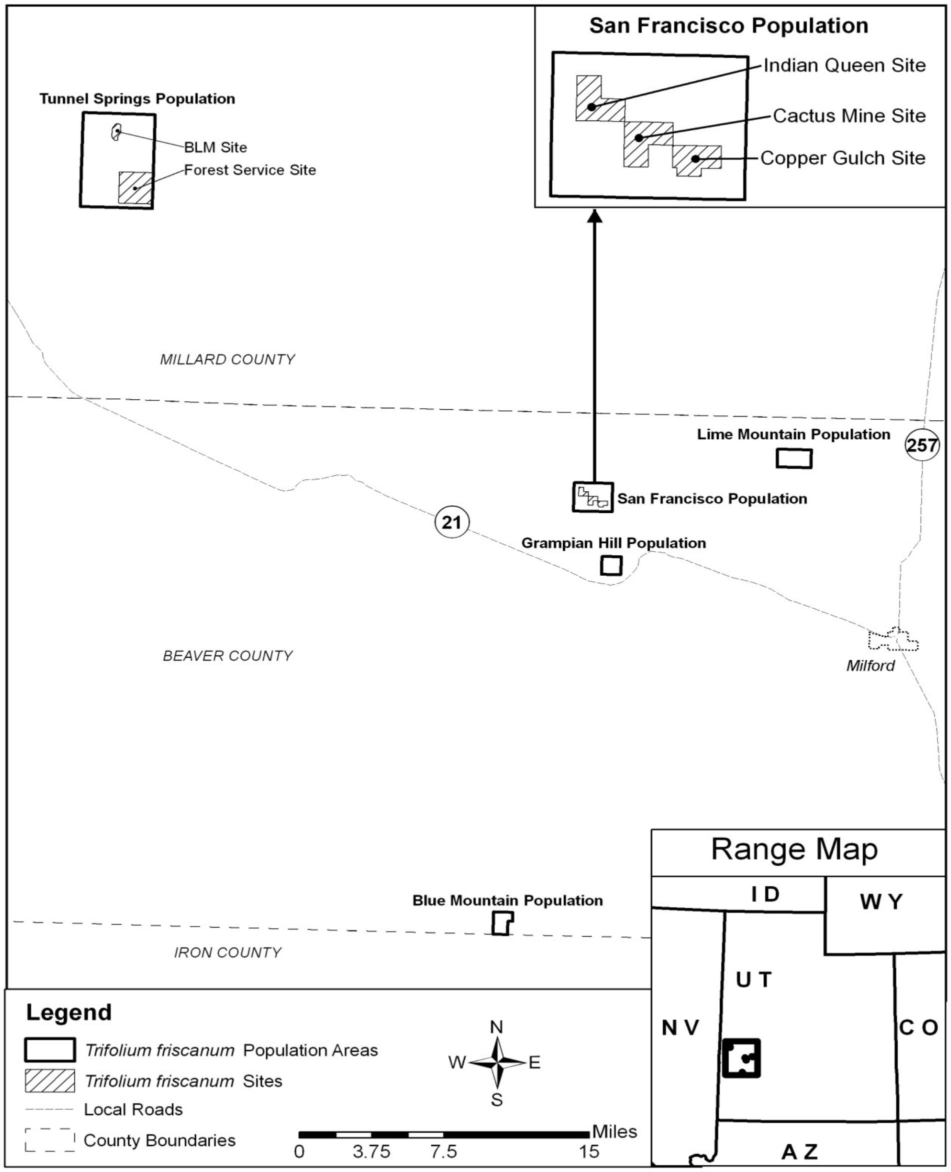

Figure 1. Frisco clover range.

Frisco clover populations extend about 40 mi (64 km) from the San Francisco Mountains and stretch across 650 square miles (sq mi)(1,684 square kilometers (sq km))(Figure 1). Within that area, the five populations are scattered in small, disjunct areas of occupied habitat (Figure 1; Table 1).

The majority of plants (71 percent of the estimated populations) are located in the San Francisco and Grampian Hill populations (Miller 2010g, Appendix B). Total occupied habitat for these two populations (four sites) is approximately 35 ac (14 ha), each site ranging between approximately 1 ac (0.4 ha) and 12 ac (5 ha) (Darnall *et al*. 2010, entire). The Blue Mountain population occupies an area of approximately 0.33 ac (0.13 ha) (Darnall *et al*. 2010, entire). We do not have areas of occupied habitat for the Tunnel Springs sites (Tunnel Springs population) or the Lime Mountain population, but we assume the area of occupied habitat to be similar to or smaller than the San Francisco, Grampian Hill, and Blue Mountain populations, because the

Tummel Springs and Lime Mountain populations contain fewer than or similar numbers of plants as those estimated for the other sites (Table 1).

Population Estimates/Status:

The total number of Frisco clover individuals in Table 1 was derived from observational counts or estimates. For the Grampian Hill population, the estimate was “many thousands” (Miller 2010a, pers. comm.). For the purpose of this notice of review, “many thousands” is interpreted as approximately 5,000 individuals. We did this because we knew there were more than a thousand, but likely less than 10,000. Four of the 9 sites contain 500 or fewer plants (Table 1).

The population estimates were not based on actual counts of plants but on cursory observations with inherent observer biases. Plants grow in dense mat-forming clusters, making it difficult to determine the number of individuals within a cluster. Because individual plants are difficult to distinguish, we do not believe that the variation in population estimates reflects variation in population sizes, but is rather an artifact in survey effort and methods used. Many of the sites occur on private lands where access is restricted, so population counts are estimated from observations.

Accordingly, the available population estimates are highly variable and probably not accurate. During the 1990s, population estimates ranged from 3,500 individuals (Evenden 1998, Appendix C) to approximately 6,000 individuals (Kass 1992, p. 8). In 2010, the total number of plants was estimated at roughly 12,175 (Table 1; Miller 2010a, pers. comm.; Miller 2010c, pp. 1, 4; Miller 2010d, p. 1; Roth 2010a, p. 4). Because of the uncertainty in the population estimates and the differences in methodologies used to survey the populations, we are unable to make accurate assessments regarding the trend for the species.

Table 1. Estimated number of Frisco clover plants (Evenden 1998, Appendix C; Miller 2010a, pers. comm.; Miller 2010c, pp. 1, 4; Miller 2010d, p. 1; Roth 2010, p. 4).

Population	**Land Ownership/Sites**	**Estimated Number of Frisco Clover Plants**
Blue Mountain	SITLA (1 site)	250
Grampian Hill	Private (1 site)	5,000*
San Francisco	BLM (Copper Gulch) (1 site)	1,000
San Francisco	Private (Cactus Mine) (1 site)	300
San Francisco	Private (Indian Queen) (1 site)	3,000
Lime Mountain	BLM (1 site)	at least 125
Tunnel Springs Mountains	BLM (1 site)	500
Tunnel Springs Mountains	USFS (2 sites)**	2,000
	ESTIMATED TOTAL	12,175

* There are many thousands of plants at this location, we are assuming 5,000.
** Last surveyed in 1992. All other survey data from 2010.

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Our February 23, 2011, 12-month finding (76 FR 10166) evaluated multiple potential threats to Frisco clover under Factor A: livestock grazing, recreational activities, mining, and nonnative invasive species. However, as explained in our 12-month finding, livestock grazing and recreational activities do not currently threaten the species. Therefore, our discussion below focuses on the primary threats under Factor A affecting the species, including habitat destruction and associated impacts from precious metal and gravel mining on private lands, and the invasion of nonnative species throughout the species' range (see **Nonnative Invasive Species** section below).

Mining

Mining activities occurred historically throughout Frisco clover's range and continue to impact the species. Mining activities can impact Frisco clover by removing habitat substrate, increasing erosion potential, fragmenting habitat through access road construction, degrading suitable habitat, and increasing invasive plant species (Brock and Green 2003, p. 15; BLM 2008a, pp. 448–449). Impacts to Frisco clover individuals include crushing and removing plants, reducing plant vigor, and reducing reproductive potential through increased dust deposits, reduced seedbank quantity and quality, and decreased pollinator availability and habitat (Brock and Green 2003, p. 15; BLM 2008a, pp. 448–449). Three out of the five known populations of Frisco clover are located at historical precious metal mines or gravel mines, with two of these populations comprising the vast majority (71 percent) of the known estimated population of Frisco clover.

The San Francisco Mountains have an extensive history of precious metal mining activity (Evenden 1998, p. 3). Precious metal mining in the southern San Francisco Mountains is likely to impact the Grampian Hill and San Francisco populations of Frisco clover (Table 2). The Grampian Hill population is located in the area of the King David Mine, which is part of the historical Horn Silver Mine. The San Francisco population is in the vicinity of mine shafts near the Cactus Mine, an historical copper mine. Although large-scale precious metal mining in the area ceased decades ago, we believe mining is likely to occur again in the foreseeable future due to patent rights and ongoing exploration for silver, zinc, and copper deposits—including recent exploration activities at the Horn Silver Mine. Precious metal mining in the vicinity of the Grampian Hill and San Francisco populations is of concern because these populations comprise the species' largest known populations, containing the vast majority of known individuals (9,300 individuals, or 71 percent of the species' estimated total population) (Table 1).

The Lime Mountain population has experienced precious metal mining activity in the past (Table 2; Miller 2010h, pp. 6–7). The last mining activity occurred in the early 1980s. We do not anticipate additional mining, due to the small amounts of minerals that were extracted (Miller 2010h, p. 7). We are not aware of precious metal mining activities in the vicinity of the Blue Mountain or Tunnel Springs populations.

Table 2. Mining activities in the habitat of Frisco clover.

Population	Historical Activity	Current Activity	Future Activity
Blue Mountain	gravel quarrying	active	gravel quarrying
Grampian Hill	silver, lead, copper, zinc (Horn Silver Mine)	none	silver, lead, copper, zinc, landscape gravel quarrying

San Francisco	silver, lead, copper, zinc, gravel quarrying (Cactus Mine)	active	silver, lead, copper, zinc, landscape gravel quarrying
Lime Mountain	silver, lead, copper, zinc, native gold, iron (Skylark, Independence & Galena Mines)	none	unknown
Tunnel Springs Mountains	unknown	none	unknown

In addition to mining for precious metals, gravel mining is known to occur within Frisco clover's range, particularly in the San Francisco Mountains and Wah Wah Mountains.

Gravel mining in the southern San Francisco Mountains is likely to impact the San Francisco population of Frisco clover and possibly the Grampian Hill population (Table 2). Frisco clover occurs on soils derived from Ordovician limestone. In addition to precious metals, this formation is mined for crushed limestone. The limestone is removed from quarry sites and sold for marble landscaping gravel. Marble landscaping gravel quarries in Frisco clover's range are open-pit mines that result in the removal of the habitat substrate for these species.

We estimate that 19 ac (8 ha) of suitable habitat is disturbed by gravel mining activities near the San Francisco population of Frisco clover. Two quarries are located within 1,000 ft (300 m) of two sites (Cactus Mine and Copper Gulch) of the San Francisco population of Frisco clover. Based on habitat similarities and proximity, we believe the plant may have occupied these areas prior to the mining activity. Gravel pits in this area are considered active because they are not reclaimed. Given their close proximity to known Frisco clover plants, these gravel pits could impact the remaining occupied habitat of the species through additional quarrying activities (i.e., removal of the entire substrate) or when roads and other infrastructure are constructed. The San Francisco population currently occupies only 15 ac (6 ha) of habitat, distributed in three sites (Copper Gulch, Cactus Mine, and Indian Queen) (Figure 1; Table 1; Darnall *et al*. 2010, entire).

Gravel mining also may impact the Grampian Hill population of Frisco clover in the future. Although gravel mining is not actively occurring at Grampian Hill, gravel pits exist within 1 mile (mi)(1.6 kilometers (km)) of this Frisco clover population. We do not know if gravel mining will definitely occur at the Grampian Hill population. However, mining operations are expected to either expand from the vicinity of the Cupric Mine or be moved to a new location within the species' habitat in the near future (Munson 2010, pers. comm.). Due to the limited extent of the Ordovician limestone deposits across the landscape, it is plausible that mining activities could occur at the Grampian Hill population. Even if gravel mining does not occur at the Grampian Hill population, we previously established that this population is likely to be impacted by precious metal mining.

A similar overlap in habitat types and gravel quarrying (Table 2) occurs for this species in the Blue Mountain population. The Blue Mountain population, which is less than 1 ac (0.4 ha) in size, is located on SITLA lands within 300 to 500 feet (91 to 152 meters) of a gravel pit (Evenden 1998, p. 9; Roth 2010, p. 4). This mine is not reclaimed and, therefore, is considered active (Darnall *et al*. 2010, entire). Therefore, we assume that continued gravel mining will ultimately impact this population if it has not already occurred. The need for gravel sources is expected to increase, because an increasing human population growth in nearby Washington and Iron counties (U.S. Census Bureau 2010b, entire; Utah GOPB 2010, p. 48) will result in the need for increased road construction and maintenance in the future. The gravel in the Blue Mountain is mined for road construction projects, mining for gravel will lead to the degradation and loss of suitable habitat for Frisco clover.

Construction sand, gravel, and crushed stone together rank as the second most valuable commodity produced among industrial minerals in Utah (Bon and Krahulec 2009, p. 5). Gravel, stone, and rock are generally mined for local and regional distribution due to the high cost of transport. The quarries in the San Francisco Mountains are the closest crushed limestone quarries to Washington County, one of the fastest growing counties in Utah. In general, there has been a net loss of local sand and gravel supply pits in the Washington County area due to ongoing urban development and the lack of available gravel pit operations on surrounding Federal lands (Blackett and Tripp 1999, p. 33). Thus, the Blue Mountain population area could become a primary source of gravel for Washington County and other nearby communities, especially because the pit's location on SITLA lands limits the need for environmental regulations. Overall, it is likely that an increasing human population growth in Washington County (U.S. Census Bureau 2010b, entire; Utah GOPB 2010, p. 48) will result in an increased demand for the limestone and gravel resources at and near known populations of Frisco clover.

To summarize, mining throughout large portions of Frisco clover's range has impacted available habitat. Three of the five known populations are located at historical precious metal mines or gravel mines on private and SITLA lands (Table 1; Table 2). Two of these populations (San Francisco and Grampian Hill) comprise the vast majority (71 percent) of the known estimated population of Frisco clover (Table 1). Precious metal mining is likely to impact populations of Frisco clover in the foreseeable future, particularly in the vicinity of the large Grampian Hill and San Francisco populations. Gravel mining is expected to increase in response to increased population growth and limited availability of active gravel pits in nearby Washington County. Available information suggests that three of five populations will be significantly impacted by either precious metal or gravel mining in the foreseeable future. Therefore, mining is a threat to Frisco clover now and in the foreseeable future.

Nonnative Invasive Species

The spread of nonnative invasive species is considered the second largest threat to imperiled plants in the United States (Wilcove *et al*. 1998, p. 608). Invasive plants—specifically exotic annuals—negatively affect native vegetation, including rare plants. One of the most substantial effects is the change in vegetation fuel properties that, in turn, alter fire frequency, intensity, extent, type, and seasonality (Menakis *et al*. 2003, pp. 282–283; Brooks *et al.* 2004, p. 677; McKenzie *et al*. 2004, p. 898). Shortened fire return intervals make it difficult for native plants to reestablish or compete with invasive plants (D'Antonio and Vitousek 1992, p. 73). Invasive plants can exclude native plants and alter pollinator behaviors (D'Antonio and Vitousek 1992, pp. 74–75; DiTomaso 2000, p. 257; Mooney and Cleland 2001, p. 5449; Levine *et al*. 2003, p. 776; Traveset and Richardson 2006, pp. 211–213). For example, *Bromus tectorum* (cheatgrass) outcompetes native species for soil nutrients and water (Melgoza *et al*. 1990, pp. 9–10; Aguirre and Johnson 1991, pp. 352–353).

The annual nonnative invasive grass, cheatgrass, is considered the most ubiquitous invasive species in the Intermountain West due to its ability to rapidly invade native dryland ecosystems and outcompete native plant species (Mack 1981, p. 145; Mack and Pyke 1983, p. 88; Thill *et al*. 1984, p. 10). If already present in the vegetative community, cheatgrass increases in abundance after a wildfire, increasing the chance for more frequent fires (D'Antonio and Vitousek 1992, pp. 74–75). In addition, cheatgrass invades areas in response to surface disturbances (Hobbs 1989, pp. 389, 393, 395, 398; Rejmanek 1989, pp. 381–383; Hobbs and Huenneke 1992, pp. 324–325, 329, 330; Evans *et al*. 2001, p. 1308). Cheatgrass is likely to increase due to climate change (see Factor E) because invasive annuals increase biomass and seed production at elevated levels of carbon dioxide (Mayeux *et al*. 1994, p. 98; Smith *et al*. 2000, pp. 80–81; Ziska *et al.* 2005, p. 1328).

Cheatgrass occurs in the habitat and vicinity of the Grampian Hill and San Francisco Frisco clover populations, which also is where the majority of plants occur (Table 1; Miller 2010c, pp. 2–5; Roth 2010, p. 1). Surface disturbances increase the occurrence and densities of cheatgrass (Mack 1981, p. 145). Increased mining activities and associated surface disturbances are expected to occur in and adjacent to the occupied habitat for Frisco clover in the San Francisco and Blue Mountains (see Mining, above), consequently encouraging cheatgrass to expand into the species' habitat. We do not know whether cheatgrass occurs in the other three populations, but given the ubiquitous distribution of cheatgrass in the Intermountain West, we expect it occurs in the vicinity of all populations (Novack and Mack 2001, p. 115).

Invasions of annual nonnative species, such as cheatgrass, are well documented to contribute to increased fire frequencies (Brooks and Pyke 2002, p. 5; Grace *et al*. 2002, p. 43; Brooks *et al*. 2003, pp. 4, 13, 15). The risk of fire is expected to increase from 46 to 100 percent when the cover of cheatgrass increases from 12 to 45 percent or more (Link *et al*. 2006, p. 116). In the absence of exotic species, it is generally estimated that fire return intervals in xeric sagebrush communities range from 100 to 350 years (Baker 2006, p. 181). In some areas of the Great Basin (Snake River Plain), fire return intervals due to cheatgrass invasion are now between 3 and 5 years (Whisenant 1990, p. 4). Most plant species occurring within a sagebrush ecosystem, including Frisco clover, are not expected to be adapted to frequent fires, as evidenced in the lack of evolutionary adaptations found in other shrub-dominated fire-adapted ecosystems like chaparral. Examples of such adaptations would include re-sprouting and heat-stimulated seed germination (Baker, in press, p. 17).

In the absence of annual nonnative species, Frisco clover grows in sparsely vegetated communities that are unlikely to carry fires (see Habitat/Life History section). Thus, Frisco clover is unlikely to be adapted to fire and, therefore, unlikely to persist through a fire. Therefore, the potential expansion of invasive species and associated fire is a threat to the species, especially when considering the limited distribution of the species and the high potential of stochastic extinctions (as discussed in the Small Population Size, Factor E, below). As described in the Current Distribution section, the majority of plants are located within the Grampian Hill and San Francisco populations, where occurrences of cheatgrass are documented. Occupied habitat in these populations ranges from 1 to 12 ac (0.4 to 5 ha).

In summary, cheatgrass occurs in the two largest Frisco clover populations (Grampian Hill and San Francisco populations, Table 1). Given the ability of cheatgrass to rapidly invade dryland ecosystems (Mack 1981, p. 145; Mack and Pyke, 1983, p. 88; Thill *et al*. 1984, p. 10), we expect it to increase in the future in response to surface disturbance from increased mining activities and global climate change (see Factor E). An increase in nonnative species is expected to increase the frequency of fires in Frisco clover's habitat. Therefore, nonnative invasive species are a threat to two of five populations of Frisco clover and the majority of individuals now, and may impact all populations in the foreseeable future when evaluated cumulatively with mining activities (and associated surface disturbances), climate change, and fire.

Summary of Factor A

Mining activities impacted Frisco clover habitat in the past and continue to be a threat to the species and its habitat throughout large portions of its range. Two of the five populations and the majority of individuals are located on lands with an extensive history of precious metal mining; ongoing exploration activities indicate that precious metal mining is likely to threaten the species in the foreseeable future. The main threat to the majority of Frisco clover plants is gravel mining (Table 2). Three of the five populations are located in the vicinity of gravel pits that are mined for road and landscaping gravel. The three populations located in the vicinity of gravel mines contain the majority of plants and may be mined for gravel in the future (Table 2). Future mining in these areas will likely result in the loss of large numbers of individuals or even entire populations. We anticipate an increase in the demand for precious metals and landscape rock based on the economic outlook for these commodities, regional availability, and the proximity of these gravel mines to a rapidly expanding urban area and, therefore, an increase in impacts to Frisco clover.

Cheatgrass is documented to occur in the two largest of the five populations of Frisco clover. The threat of fire caused by annual nonnative species invasions is exacerbated by mining activities and global climate change (see Factor E). Small population sizes and extremely limited distribution of this species make it especially vulnerable to stochastic extinction events, including mining activities and wildfires caused by increased invasions of nonnative species (see Factor E).

Therefore, Frisco clover is threatened by the present or threatened destruction, modification, or curtailment of the species' habitat or range, now and in the foreseeable future, based on impacts from mining activities and nonnative invasive species.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

Frisco clover is not a plant of horticultural interest. We are not aware of any overutilization or collection of Frisco clover. Therefore, overutilization for commercial, recreational, scientific, or educational purposes does not appear to pose a significant threat to the species now nor is it likely to become a threat in the foreseeable future.

C. Disease or predation:

Disease and herbivory on the species are unknown. We do not have any information indicating that disease is impacting Frisco clover. We also do not have any information indicating that herbivory is occurring from livestock, wildlife, or insects (Kass 1992, p. 10; Evenden 1998, entire; Evenden 1999, entire; Miller 2010a, p. 1; Miller 2010c, entire; Roth 2010, entire). Thus, we do not consider disease or predation to be threats to this species.

D. The inadequacy of existing regulatory mechanisms:

There are no endangered species laws protecting plants on private, State, or Tribal lands in Utah. The majority (70 percent) of individual plants are located on SITLA or private lands (Table 1). Frisco clover is listed as a bureau-sensitive plant for the BLM. Limited policy-level protection by the BLM is afforded through the Special Status Species Management Policy Manual # 6840, which forms the basis for special status species management on BLM lands (BLM 2008b, entire). The two sites on USFS lands are located within the Desert Experimental Range in the Tunnel Springs Mountains (Tunnel Springs population) and appear to be secure, although the population has not been visited since 1992 (Kass 1992, p. 11; Evenden 1998, Appendix C; Evenden 1999, p. 3).

This species is predominantly located on private or SITLA lands (Table 1), where it is threatened by mining-related activities (see Factor A). There are limited regulatory mechanisms in place that may protect Frisco clover from mining on private or State lands. State environmental impact assessments are required for large mining operations (or operations above 5-ac (2-ha) in size) for all mineral exploration, development, and extraction, including gravel pits and precious metal mining (UDOGM 2010b, p. 1; Baker 2010, pers. comm.). Frisco clover is not State listed, but it is on the BLM sensitive species list. If UDOGM is made aware of impacts to these species, they could consider minimizing and mitigating impacts; however, there is no requirement to address species that are not federally listed in UDOGM's mine permitting process (Baker 2010, pers. comm.).

The existing mining activities (see Factor A) are under UDOGM's 5-ac (2-ha) regulatory threshold and, therefore, not subject to permitting laws (Munson 2010, pers. comm.). A few of the gravel mine pits almost exceed the 5-ac (2-ha) limit, and the operators may need to apply for permits (Munson 2010, pers. comm.); however, they also could choose to begin new gravel pits, or reclaim portions of the existing pits to remain below the 5-ac (2-ha) limit (Munson 2010, pers. comm.).

In summary, the existing regulatory mechanisms are not adequate to protect Frisco clover from becoming threatened or endangered by precious metal or gravel mining on SITLA and private lands. The active gravel pits are below the 5-ac (2-ha) threshold that would automatically trigger regulatory environmental impact assessments. However, even if an environmental impact assessment is completed for any of the mines, the existing mining laws only recommend, and do not mandate, the species' protection or mitigation. Therefore, the inadequacy of existing mechanisms to regulate mining activities on private and State lands is a threat to three of five populations with the majority of individuals, and thus to Frisco clover now and into the foreseeable future.

E. Other natural or manmade factors affecting its continued existence:

Natural and manmade threats to Frisco clover's survival include small population size and climate change and drought.

Small Population Size

Small populations and species with limited distributions are vulnerable to relatively minor environmental disturbances (Given 1994, pp. 66–67). No information is available on the population genetics, pollination, or reproductive effort and success of Frisco clover. However, we do know that small populations are at an increased risk of extinction due to the potential for inbreeding depression, loss of genetic diversity, and lower sexual reproduction rates (Ellstrand and Elam 1993, entire; Wilcock and Neiland 2002, p. 275). Lower genetic diversity may, in turn, lead to even smaller populations by decreasing the species' ability to adapt, thereby increasing the probability of population extinction (Barrett and Kohn 1991, pp. 4, 28; Newman and Pilson 1997, p. 360).

The entire range of Frisco clover is restricted to highly specialized habitat niches, distributed in 5 populations (and 9 sites) with a total population estimate of 12,175 plants. Four of the 9 sites contain 500 or fewer individuals (Table 1). Only a fraction of the entire species' range is occupied habitat. The majority of plants are located in two populations containing four sites of occupied habitat, ranging from an estimated 1 ac (0.4 ha) to a maximum of 12 ac (5 ha) (Darnall *et al*. 2010, entire; Miller 2010g, Appendix B).

Mining or a single random event, such as a wildfire from invasive species (see Factor A), could extirpate an entire or at least a substantial portion of a population, given the small areas of occupied habitat. Species with limited ranges and restricted habitat requirements also are more vulnerable to the effects of global climate change (see Climate Change and Drought, below) (IPCC 2002, p. 22; Jump and Penuelas 2005, p. 1016; Machinski *et al*. 2006, p. 226; Krause 2010, p. 79).

Overall, we consider small population size an intrinsic vulnerability to Frisco clover, which may not rise to the level of a threat on its own. However, the small population sizes rise to the level of a threat because of the combined effects of having only five highly localized small populations with the effects of global climate change (see below) and the potential for stochastic extinction events such as mining, and fire induced by invasive species (see Factor A). Therefore, we consider small localized population size, in combination with mining, invasive species, and climate change, to be a threat to the species now and in the foreseeable future.

Climate Change and Drought

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Climate change is likely to affect the long-term survival and distribution of native species, including Frisco clover. Predicted changes in climatic conditions include increases in temperature, decreases in rainfall, and increases in atmospheric carbon dioxide in the American Southwest (Walther *et al*. 2002, p. 389; IPCC 2007, p. 48; Karl *et al*. 2009, p. 129). Hot extremes, heat waves, and heavy precipitation will increase in frequency, with the Southwest experiencing the greatest temperature increase in the continental United States (Karl *et al*.

2009). Approximately 20 to 30 percent of plant and animal species are at increased risk of extinction if increases in global average temperature exceed 2.7 to 4.5 degrees Fahrenheit (°F) (1.5 to 2.5 degrees Celsius (°C)) (IPCC 2007, p. 48). In the southwestern United States, average temperatures increased approximately 1.5 °F (0.8 °C) compared to a 1960 to 1979 baseline (Karl *et al*. 2009, p. 129). By the end of this century, temperatures are expected to warm a total of 4 to 10 °F (2 to 5 °C) in the Southwest (Karl *et al*. 2009, p. 129).

Annual mean precipitation levels are expected to decrease in western North America and especially the southwestern States by mid-century (IPCC 2007, p. 8; Seager *et al*. 2007, p. 1181). The levels of aridity of recent drought conditions and perhaps those of the 1950s drought years will become the new climatology for the southwestern United States (Seager *et al*. 2007, p. 1181). Although droughts occur more frequently in areas with minimal precipitation, even a slight reduction from normal precipitation may lead to severe reductions in plant production. Therefore, the smallest change in environmental factors, especially precipitation, plays a decisive role in plant survival in arid regions (Herbel *et al*. 1972, p. 1084).

Atmospheric levels of carbon dioxide are expected to double before the end of the 21st century, which may increase the dominance of invasive grasses leading to increased fire frequency and severity across western North America (Brooks and Pyke 2002, p. 3; IPCC 2002, p. 32; Walther *et al*. 2002, p. 391). Elevated levels of carbon dioxide lead to increased invasive annual plant biomass, invasive seed production, and pest outbreaks (Smith *et al*. 2000, pp. 80–81; IPCC 2002, pp. 18, 32; Ziska *et al*. 2005, p. 1328) and will put additional stressors on rare plants already suffering from the effects of elevated temperatures and drought.

Although we have no information on how Frisco clover will respond to effects related to climate change, persistent or prolonged drought conditions are likely to reduce the frequency and duration of flowering and germination events, lower the recruitment of individual plants, compromise the viability of populations, and impact pollinator availability (Tilman and El Haddi 1992, p. 263; Harrison 2001, p. 78).

Drought conditions led to a noticeable decline in survival, vigor, and reproductive output of other rare and endangered plants in the Southwest during the drought years of 2001 through 2004 (Anderton 2002, p. 1; Van Buren and Harper 2002, p. 3; Van Buren and Harper 2004, entire; Hughes 2005, entire; Clark and Clark 2007, p. 6; Roth 2008a, entire; Roth 2008b, pp. 3–4). Similar responses are anticipated to adversely affect the long-term persistence of Frisco clover.

As discussed in the Small Population Size section above, Frisco clover has a limited distribution and populations are localized and small. In addition, these populations are restricted to very specific soil types. Global climate change exacerbates the risk of extinction for species that are already vulnerable due to low population numbers and restricted habitat requirements (IPCC 2002, p. 22; Jump and Penuelas 2005, p. 1016; Machinski *et al*. 2006, p. 226; Krause 2010, p. 79).

The actual extent to which climate change itself will impact Frisco clover is unclear, mostly because we do not have long-term demographic information that allows us to predict the species’ response to changes in environmental conditions, including prolonged drought. However, as previously described, the species is threatened by mining activities (see Factor A, above), which will likely result in the loss of large numbers of individuals or even entire populations. Increased surface disturbances associated with mining activities also will likely increase the extent and densities of nonnative invasive species and, with these, the frequencies of fires (see Factor A, above). The cumulative effects of the potential reduction in population numbers and habitat loss (of already small populations) associated with mining and increased invasive species (and fire) are likely to increase the risk of the species being impacted by changes in climate.

In summary, we find it difficult to analyze the potential effects of global climate change on Frisco clover in the absence of demographic trend data for the species which would allow us to analyze how the species responds to climate change through time. However, the cumulative effects posed by the threats of mining, nonnative species and small population size may exacerbate the effects of climate change on Frisco clover in the future. However, at this time, we believe that the state of knowledge concerning the localized effects of climate change within the habitat occupied by Frisco clover is too speculative to determine whether climate change is a threat to this species in the foreseeable future. We will continue to assess the potential of climate change to threaten the species as better scientific information becomes available.

Summary of Factor E

We assessed the potential risks of small population size, climate change, and drought to Frisco clover populations. Frisco clover has a highly restricted distribution and is known from five small, localized populations. Even in the absence of information on genetic diversity, inbreeding depression, and reproductive effort, a random stochastic event could impact a significant portion of a population. Small populations that are restricted by habitat requirements are also more vulnerable to the effects of climate change, such as prolonged droughts and increased fire frequencies.

While naturally occurring droughts are not likely to impact the long-term persistence of the species, an increase in periodic prolonged droughts due to climate change is likely to impact the species across its entire range in the future. Global climate change, particularly when assessed cumulatively with small population size and threats from mining activities, is expected to increase the density of invasive annual grasses, which are already present in the habitat of Frisco clover within the populations that contain the majority of the plants (see Factor A). Increased nonnative species in the habitat of Frisco clover can increase fire frequency and severity. Because Frisco clover is not likely adapted to persist through fires, wildfires can have a significant impact on these small populations.

Although small population size and climate change make the species intrinsically more vulnerable, we are uncertain whether they would rise to the level of threat by themselves. However, when combined with the threats listed under Factor A, we believe that small population size is likely to rise to the level of threat in the foreseeable future. At this time, we are uncertain of the degree to which climate change constitutes a threat to the species. We will continue to assess the potential of climate change to threaten the species as better scientific information becomes available.

Conservation Measures Planned or Implemented :

Data collection conducted in 2010 contributed to our knowledge of the current status of Frisco clover populations. The information provided by this effort improved our understanding of the relative importance of the various factors implicated in the species' extinction risk. The BLM is working with the University of Southern Utah to create a habitat model for Frisco clover and conduct surveys in areas identified by the model as potential habitat (Pontarolo 2012, pers. comm.). Results may locate additional populations on BLM lands and provide us with a better understanding of the species' distribution, abundance, and threats. The Nature Conservancy of Utah is initiating communication with the private landowners to establish conservation measures, including the potential for conservation easements for the populations on private lands (York 2012, pers. comm.).

Summary of Threats :

The primary threat to Frisco clover is habitat destruction from precious metal and gravel mining on private and SITLA lands (Factor A). The largest populations containing the majority of Frisco clover plants are located on private lands with active mining claims. These populations were likely impacted by historical precious metal mining. Another population is located on SITLA lands in the immediate vicinity of a gravel pit. We expect an increase in precious metal and gravel mining in the foreseeable future, with the associated loss and fragmentation of Frisco clover populations.

Cheatgrass occurs in the vicinity of the two largest populations of the five known Frisco clover populations. It is a highly invasive species and is expected to increase in areas where surface disturbance such as mining occurs. The species occurs in the vicinity of gravel and precious metal mines. Mines inherently cause surface disturbances from excavation activities and the construction of roads and other infrastructure. Global climate change is expected to increase drought conditions in the Southwest and increase the spread of nonnative invasive species. The biggest concern associated with the increase in invasive species is the threat of increased wildfire (Factor A), particularly when considering the small population sizes and small occupied habitat acreages associated with the species.

The magnitude of the biological threats posed by the small population size and limited species range are not well understood due to the lack of information available on the ecology of Frisco clover. Future studies may provide us with a more thorough understanding of threats posed by pollinator limitation, inbreeding depression, and the potential lack of genetic diversity over the species' range. Even without detailed knowledge on how small population sizes are impacting the biology and ecology of Frisco clover, the small areas of occupied habitat make the species highly vulnerable to habitat destruction through mining-related activities as well as random extinction events, including fires and the effects of global climate change (Factor E).

The existing regulatory mechanisms are not adequate to protect Frisco clover from the primary threat of mining, particularly because the majority of individuals are located on private lands (Factor D). The inadequacy of regulatory mechanisms (Factor D) on private and State lands, combined with the high economic and commercial value of much of the substrate this species depends on, poses a serious threat to Frisco clover. A large portion of the species' individuals have the potential to be extirpated by mining activities in the foreseeable future (Factor A; Table 2). Ongoing mining in the habitat of Frisco clover has the potential to extirpate three of the five populations in the foreseeable future, two of which contain the majority of plants (Factor A, Table 1).

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

- Determine habitat suitability on federal lands and survey for additional populations.
- Pursue habitat protection for existing populations on SITLA and private lands through land purchases or exchanges, conservation easements, and candidate conservation agreements.

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	**Imminent**	Monotypic genus	7
		Species	**8**
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

Moderate. We consider the threats that Frisco clover faces to be moderate in magnitude because the major threats (mining, nonnative species, small population size, climate change, and inadequacy of existing regulatory mechanisms), while serious and occurring rangewide, do not collectively rise to the level of high magnitude. For instance, although mining for precious metals and gravel historically occurred throughout Frisco clover's range, and mining operations may eventually expand into occupied habitats, there are no active mines within the immediate vicinity of any known population [except for an unreclaimed gravel mine within several hundred feet of the small, approximately 1-ac (0.4-ha) Blue Mountain population]. By removing the unique limestone and dolomite soils, mining physically reduces available habitats while promoting the spread of cheatgrass. Although cheatgrass is widespread throughout Utah, cheatgrass currently occurs within only two of the five known Frisco clover population areas.

Additionally, existing regulatory mechanisms do not adequately protect the species from mining on private lands; however, because none of the populations are directly impacted by current mining, the threat of a lack of regulatory mechanisms is moderate. Finally, although small population size and climate change make the species intrinsically more vulnerable to other threats, we are uncertain whether small populations and climate change individually rise to the level of threat. When analyzed cumulatively with threats associated with mining and nonnative species, these factors may rise to the level of threat in the foreseeable future. Therefore, we consider the threats moderate in magnitude.

Imminence :

Imminent. We consider all of the threats to be imminent because the threats are identifiable and the species currently faces them across its entire range. Although gravel mining currently occurs near only one of the five populations, active permits and recent prospecting within occupied and suitable habitats suggest that mining operations may restart or expand at any time in the foreseeable future. Because the mining operations are small scale, we will likely not be notified by UDOGM when these activities within habitat occur. Additionally, cheatgrass spreads rapidly and we expect will quickly colonize the habitats of all five Frisco clover populations, further reducing available habitats and increasing the potential for detrimental wildfire. Already imminent, we expect that the threats of mining, nonnative species, small population sizes, and climate change to continue and likely intensify into the foreseeable future.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

We determine that issuing an emergency regulation temporarily listing the species is not warranted at this time because there is no emergency posing a significant risk to the well-being of Frisco clover. We do not believe that any of the potential threats are of such great immediacy and severity that would threaten all of the known populations with the imminent risk of extinction. However, if at any time we determine that issuing an emergency regulation temporarily listing Frisco clover is warranted, we will initiate emergency listing at that time.

Description of Monitoring:

We are coordinating with the BLM's Cedar City Field Office to develop a geographic information system (GIS) habitat model and we anticipate that BLM will conduct surveys of potential habitat. We are also coordinating with the Nature Conservancy to pursue landowner contact and open a dialogue on the conservation of the species on private lands.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Utah

Indicate which State(s) did not provide any information or comment:

none

State Coordination:

Frisco clover is endemic to Utah. The BLM's Cedar City Field Office in Utah provided information and comments on this assessment. No new information about the status of this species was available from the Utah Natural Heritage Program (UNHP) for this review. The UNHP actively tracks the status of this species and we will incorporate any updates or new information gathered in future assessments.

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Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: Noreen E Walsh ______________________ 05/31/2012

Date

Concur: 11/06/2012
Date

Did not concur: ______________________ ______________
Date

Director's Remarks: